

geons) should be consulted to confirm the diagnosis because conditions that mimic brain death but are often reversible—such as drug and metabolic intoxication, hypothermia and shock—may exist. Once physicians have made a careful determination of brain death, they should discuss the concept with the patient's family and explore the possibility of organ donation, if clinically feasible and otherwise appropriate. After a patient has been pronounced dead, removing the ventilator has no greater ethical or legal significance than stopping any other treatment for a dead patient.

Permanently unconscious patients present a different problem. Legal concerns added to the inherent limitations of neurologic prognoses frequently make physicians hesitate to classify patients as permanently unconscious. After a sufficient period of observation and adequate clinical evaluation, a physician's confidence in the diagnosis of permanent unconsciousness may lead to a favorable response when the patient's family or surrogate (a legally recognized representative of the patient) requests the withdrawal of treatment, thus allowing the patient to die.

These requests create an ethical issue. In 1981, both the Judicial Council of the American Medical Association and the Los Angeles County Medical Association—supported by the Council of the California Medical Association—endorsed the ethical propriety of withdrawing ventilator support from patients in an "irreversible coma" (a state of permanent unconsciousness), so long as the family concurred and the patient had expressed no contrary wish before the neurologic crisis. In 1983, a Presidential Commission urged that patients' families be recognized as primary decision makers in such cases, stating that "the law does not and should not require any particular therapies to be applied or continued, with the exception of basic nursing care that is needed to ensure dignified and respectful treatment of the patient." In addition, a California appellate court dismissed criminal charges against two physicians in a 1983 case involving the discontinuance of both ventilator and fluid support for a deeply comatose patient. The court held that a physician has no duty to continue treatment that will not improve a patient's prognosis for recovery, that has become futile and that offers no reasonable medical benefit to the patient in terms of a return to a "normal, functioning, integrated existence."

Antibiotics, blood products, cardiac drugs, dialysis, pressor agents and ventilators all might be used as life-sustaining treatment for permanently unconscious patients. No logical distinction can be made among these modalities for such patients. When the family or surrogate concurs and when the decision does not conflict with the values of the patient, physicians may ethically withhold or withdraw all such forms of life-sustaining treatment. There is a caution, however. The provision of fluids and nutrition holds a deep emotional and symbolic significance for many professionals and lay persons, who see it as one element of "basic care" for such patients. To withdraw food and fluids may generate extreme controversy and even lead to sanctions.

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Interventional Neuroradiology

INTERVENTIONAL NEURORADIOLOGY has recently become an accepted treatment method for selected cases of brain and head vascular abnormalities. Treatment is carried out endovascularly, generally through an angiography catheter, and may be divided into two basic types: the opening of arteries that are too narrow and the closing of blood vessels that supply hypervascular abnormalities (arteriovenous malformations, arteriovenous fistulae and vascular neoplasms).

Unlike other areas of the body, the end organ (the brain), is unforgiving of careless technique. Introducing either atheromatous or inappropriately placed iatrogenic emboli into its circulation has grave consequences.

Starving hypervascular lesions of the brain and scalp is done by introducing small foreign particles—usually polyvinyl alcohol foam sponge particles, Gelfoam particles or silicone spheres—selectively into the arteries supplying the lesion through percutaneously placed angiography catheters. For arteriovenous malformations of the brain, one depends on the high flow into the lesion to carry the emboli to the correct place. Introducing tissue adhesives via selective intracranial catheterization may also be undertaken, but it is still considered an experimental procedure and is reserved for life-threatening situations. The goal is to control headache, reduce steal symptoms and lessen the likelihood of second or subsequent hemorrhage (this latter point has not been definitely proved and is controversial). Treating scalp arteriovenous malformations is significantly less difficult and is also safer than treating intracranial arteriovenous malformations. One may catheterize the external branches of the carotid artery and, by using direct fluoroscopic real-time visualization of the embolic process, may completely occlude the blood supply to these lesions. A knowledge of the anatomy of the blood supply of the cranial nerves is essential for maximal patient safety. Though meningiomas may be controlled surgically, there appears to be some advantage in preoperative embolization five to seven days before an operation to allow peritumoral edema to regress before the operative intervention.

It is particularly satisfying for a therapist to encounter a traumatic carotid artery to cavernous sinus fistula, as embolic results are excellent. The therapist may guide a small detachable balloon-tipped catheter into the cavernous sinus and then, using real-time fluoroscopic control, gradually inflate the balloon until flow through the fistula has been stopped. The goal of the treatment is to preserve the internal carotid artery. Acceptance of this procedure is now widespread, and few operative approaches are thus done for traumatic arteriovenous fistulae. One expects the development of third, fourth and sixth nerve pareses in from 20% to 30% of patients; the paresis resolves over the course of three to six months.

Grüntzig balloon dilatation of atheromatous vessels has been recently reported as treatment for narrowing of the prox-

imal brachiocephalic and vertebral arteries. Relatively few reports detail dilatation of the more common narrowing of the internal carotid artery bifurcation. Physicians doing this procedure note the importance of identifying and excluding from treatment patients who have ulcerated plaques. Special precautions are taken to decrease the likelihood of downstream embolization. Follow-up for this procedure is short but the early results are promising.

Patients are prepared for embolic procedures with steroids; the steroid dosages are tapered over the three days following the procedure. The advantage of embolic techniques is a considerable reduction in costs. Patients leave the hospital on the second or third posttreatment day. Complications of embolic and dilatation procedures appear to be sim-

ilar in quality and rate to the surgical approach for these diseases.

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